Airborne Topographic Mapper (ATM) Instrument Suite

The ATM instrument suite is a versatile package of airborne science instruments that can be tailored to many different science applications and platform configurations. The ATM instrument suite has collected high-precision topographic data from a wide variety of platforms, including the NASA P-3, a Chilean Navy P-3, a US Navy P-3, NOAA P-3, the NASA DC-8, the NCAR C-130, the NASA C-130, the NASA HU-25C, and a half-dozen Twin Otters. The ATM instrument suite has been adapted to various platforms, and typically operates at altitudes from 1,500 ft/450 m above ground level (AGL) (optimally) up to 35,000 ft/10000 meters. Part of the instrument suite is ATM's precision aircraft guidance system that allows to steer the aircraft precisely on the desired path to obtain overlapping data for change detection versus prior ATM surveys or spacecraft underflights. Once engaged, the ATM system steers the aircraft by comparing its GPS position with a pre-programmed desired track, and generating the appropriate signal for the autopilot to keep the aircraft aligned with the target track typically within 1.8 m of the ideal flight path. The main component of the instrument suite are two conically-scanning laser altimeters that independently measure the surface topography of a swath beneath the aircraft at a 15° and 2.5° off-nadir angle respectively. ATM instrument suite consists of:

Instrument	Scan angle	Wavelength [nm]	PRF (Hz)	Pulse Width [ns]	Swath width at 450 m AGL	Footprint size at 450 m AGL
ATM 6d-T7	2.5°	532	10,000	1.3	40 m	0.64 m
ATM 6c-T7	2.5°	1064	10,000	1.3	40 m	0.91 m
ATM 6a-T6	15°	532	10,000	1.3	245 m	0.64 m

The ATM T7 transceiver is a dual color laser with co-located green and near-infrared laser beams. Like most modern airborne laser altimeters, the ATM systems record the full waveform of the transmitted and received laser pulse. The ATM laser altimeters have an accuracy of better than 6 cm [*Martin et al.*, 2012] which has been confirmed independently in the interior of continental ice sheets for 4 generations of ATM transceivers [*Brunt et al.*, 2017; *Brunt et al.*, 2018].

Natural color digital imagery: Continuous Airborne Mapping By Optical Translator (CAMBOT): The CAMBOT camera is a Prosilica GT APS-H camera with 4896 × 3264 pixels with a 28 mm lens. At 450 m AGL the camera images a 280 meter-wide swath beneath the aircraft with a pixel resolution of 7 cm.

FLIR 655sc Thermal Imaging Camera: The camera records 16-bit 640 × 320 pixel images with over 76,000 accurate temperature measurements in every image. The thermal images slightly exceed the area the ATM wide scanner is imaging and have a pixel size of roughly 1.2 × 1.2 meters at 450 m AGL.

HeadWall Hyperspectral Imager: The HeadWall Hyperspec imager is a pushbroom sensor with a wavenumber rage from 400 – 2500 nm and dual VNIR/SWIR sensors with co-aligned pixels. The sensors have 270 (VNIR) & 267 (SWIR) spectral pixels with 640 pixels across the swath with 12 (VNIR) and 16 bit (SWIR) resolution.

References:

Brunt, K. M., R. L. Hawley, E. R. Lutz, M. Studinger, J. G. Sonntag, M. A. Hofton, L. C. Andrews, and T. A. Neumann (2017), Assessment of NASA airborne laser altimetry data using ground-based GPS data near Summit Station, Greenland, *The Cryosphere*, *11*(2), 681-692, doi:10.5194/tc-11-681-2017.

Brunt, K. M., Neumann, T. A., and Larsen, C. F.: Assessment of altimetry using ground-based GPS data from the 88S Traverse, Antarctica, in support of ICESat-2, The Cryosphere, 13, 579-590, https://doi.org/10.5194/tc-13-579-2019, 2019.

Martin, C. F., W. B. Krabill, S. S. Manizade, R. L. Russell, J. G. Sonntag, R. N. Swift, and J. K. Yungel (2012), Airborne Topographic Mapper Calibration Procedures and Accuracy Assessment *Rep.*